ABSTRACT

[0095] The disclosed methods and apparatus concern Raman spectroscopy using metal coated nanocrystalline porous silicon substrates. Porous silicon substrates may be formed by anodic etching in dilute hydrofluoric acid. A thin coating of a Raman active metal, such as gold or silver, may be coated onto the porous silicon by cathodic electromigration or any known technique. In certain alternatives, the metal coated porous silicon substrate comprises a plasma-oxidized, dip and decomposed porous silicon substrate. The metal-coated substrate provides an extensive, metal rich environment for SERS, SERRS, hyper-Raman and/or CARS Raman spectroscopy. In certain alternatives, metal nanoparticles may be added to the metal-coated substrate to further enhance the Raman signals. Raman spectroscopy may be used to detect, identify and/or quantify a wide variety of analytes, using the disclosed methods and apparatus. In some disclosed methods, Raman spectroscopy may be used to detect nucleotides, purines or pyrimidines at the single molecule level.